

## 22 OCEANIC AND OFFSHORE

The FAA is responsible for providing air traffic services to aircraft flying within specific flight information regions (FIRs). These regions include a portion of the western half of the North Atlantic Ocean, a large portion of the Arctic Ocean, and a major portion of the Pacific Ocean (see Figure 22-1). The oceanic domain consists of oceanic air route traffic control centers (ARTCCs) and offshore sites. The New York and Oakland oceanic centers are responsible for oceanic airspace, while the Anchorage ARTCC provides en route (including radar coverage) and oceanic air traffic services for all Alaskan airspace. Air traffic services provided by San Juan, Guam, and Honolulu also fall under the oceanic offshore domain. Each of these latter facilities—commonly referred to as center radar approach control (CERAP) facilities or offshore sites—is unique in terms of their air traffic control (ATC) operations and associated ATC automation systems.

The future oceanic architecture must accommodate substantial air traffic growth that is expected in oceanic and offshore airspace through automation enhancements and procedural changes. These changes will reduce separation standards—longitudinally, laterally, and vertically. The *Strategic Plan for Oceanic Airspace Enhancements and Separation Reductions*, June 1998, describes the FAA's strategy to support the overall oceanic air

traffic management (ATM) system improvement concept, including separation reduction and other airspace enhancements. A combination of ground and airborne automation capabilities and technologies in satellite-based communications, navigation, and surveillance will reduce or balance controller workloads to help oceanic service providers solve potential conflicts, traffic congestion, and demand for user-preferred trajectories. This architecture is centered around improving automation and communications capabilities in the ground system to take advantage of communications, navigation, and surveillance capabilities in aircraft avionics. A major goal of the architecture is to lower training, operations, and maintenance costs by evolving toward maximum commonality between offshore, oceanic, and domestic air traffic services.

Figure 22-2 shows that the oceanic ATC services of Oakland, Anchorage, and New York will evolve toward commonality with the en route domain, while Guam, Honolulu, and San Juan will evolve toward commonality with the terminal domain. The concept of commonality is that applications software will be common, where appropriate, but will also incorporate the domain-specific capabilities necessary for operational suitability.

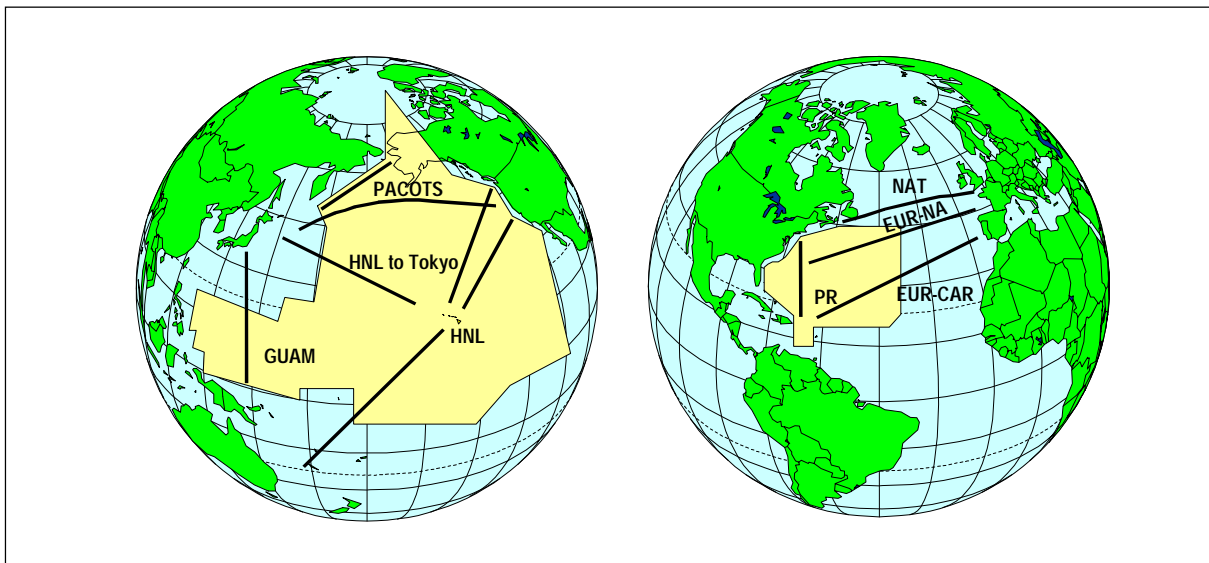


Figure 22-1. Oceanic Airspace

Oceanic airspace is an area in which airspace users can realize significant benefits from enhanced ATC system capabilities. Small improvements in fuel efficiency or reductions in flight times can create large savings in airline operating costs. Predictability of aircraft getting and staying on their preferred routing can be especially cost beneficial for the airlines.

### 22.1 Oceanic Architecture Evolution

Technical advances in automation and in satellite communications and navigation can increase user flexibility while increasing levels of capacity and safety in the oceanic and offshore domain. Automatic dependent surveillance (ADS), better navigation tools, near real-time communications, and automated data exchange between pilots and oceanic air traffic controllers via data link will provide the flexibility to change flight trajectories in response to changes in wind-optimal routes, rather than having to adhere to predefined routes that are calculated hours in advance. Oceanic service providers will have situation displays of traffic in oceanic airspace and decision support system (DSS) tools, allowing them to provide procedural separation from their displays at reduced separation minima.

Pilots will have a cockpit display of nearby traffic received via automatic dependent surveillance broadcast (ADS-B) from other aircraft. Pilots and service providers will be able to initiate and ex-

change data link messages via satellite communications (SATCOM) or high frequency data link (HFDL). Pilots will be able to negotiate climbs, descents, and specified maneuvers between affected aircraft and the oceanic service provider (see Section 16, Surveillance, and Section 17, Communications). Decision support tools will be used to help oceanic service providers detect and resolve possible conflicts and to prevent controlled aircraft from entering restricted airspace.

The role of oceanic service providers will evolve from performing procedural separation using paper strips to performing procedural separation employing situation displays and controller decision support system tools for separation and strategic planning.

The oceanic architecture will evolve through four steps leading toward commonality with the en route and terminal architectures. The evolution of the oceanic and offshore systems toward a common infrastructure will require close coordination with the acquisition efforts of other domains. These dependencies are discussed in the specific architectural steps. The applications software will become as common with other domains as appropriate. Domain unique requirements, primarily due to surveillance and communication differences, will be retained as necessary for operational suitability.

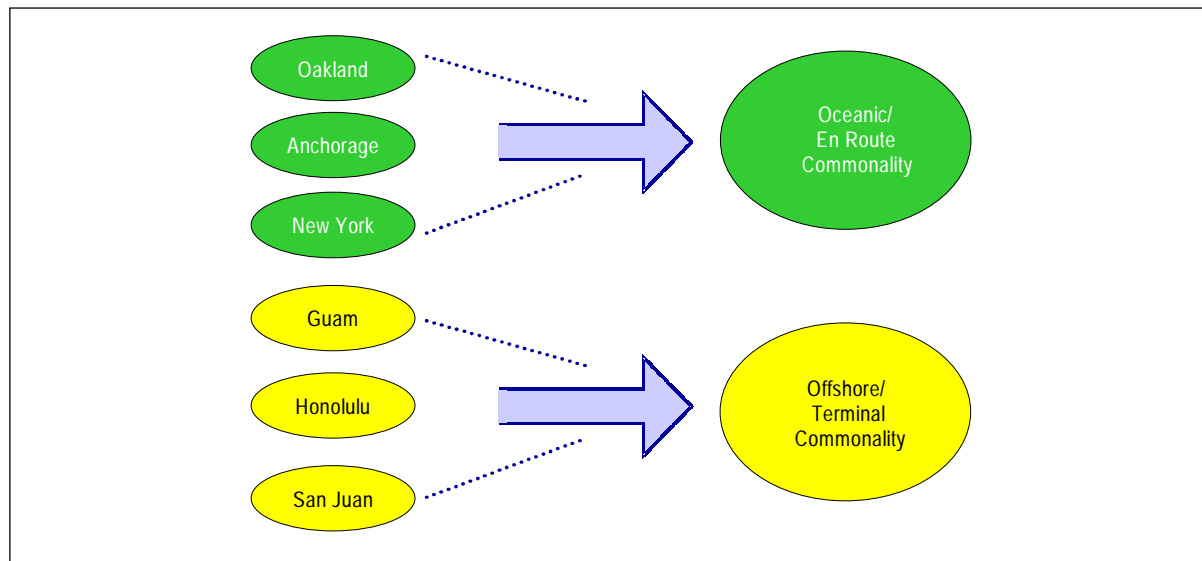


Figure 22-2. Oceanic Architecture Evolution Toward Commonality

The oceanic architecture is driven by the availability of enabling capabilities. The timing of specific capabilities is presented in Table 22-1. The table focuses on the evolutionary steps of the oceanic architecture. Table 22-2 presents the evolution of the concept of operations (CONOPS) in terms of the types of events experienced by users and oceanic ATC service providers for a typical oceanic flight in relation to the evolution of the NAS.

The oceanic architecture evolution is organized into two elements: oceanic and offshore sites. These sites include:

- New York and Oakland, which are oceanic FIRs, are discussed in Section 22.1.1, Oceanic Architecture Evolution.
- Anchorage, Guam, Honolulu, and San Juan are offshore sites and are discussed in Section 22.1.2, Offshore Architecture Evolution.

### 22.1.1 Oceanic Architecture Evolution

Currently, a number of innovative alternatives to meet oceanic user needs and commitments are being evaluated. This process could substantially affect the architectural evolution.

The architecture diagrams presented later in this section show the content of each evolutionary

**Table 22-1. Oceanic Capabilities Evolution**

	<b>1998 Current</b>	<b>1999–2007 Steps 2 and 3</b>	<b>2008–2013 Step 4</b>
Communications	HF voice through communications service provider Some FANS-1 data link	HF voice through communications service provider Direct communications FANS-1 data link (SATCOM) Some ATN Some HFDL	Rarely HF voice via communications service provider Some FANS-1 data link (SATCOM) Some HFDL Mostly ATN
Surveillance	Pilot position reports	Pilot position reports (voice or data) ADS-A ADS-B (air-air)	Some pilot position reports (voice or data) ADS-A ADS-B (air-air)
Navigation	RNP 10 Northern Pacific	RNP-10	RNP-4
Separation Standards	60-100 nmi long/lat 2,000 ft vertical 50 lateral nmi In-trail climb, descents RVSM Atlantic	50 nmi lateral leading to 50/50 nmi RVSM expanded to other areas Limited self-separation procedures	Additional self-separation procedures (Shared separation responsibility) RVSM
Airspace Structure	Fixed Flexible Random	Less fixed More flexible More Random	Random User-preferred profiles
Interfacility Comm	Voice Teletype NAS-to-NAS Initial AIDC	Voice Teletype NAS-to-NAS Data (e.g., AIDC)	Mostly data (e.g., AIDC) Some voice Some teletype NAS-wide information network
User/ATM interactions	User files flight plan User and TFM negotiate oceanic fix crossing time	Defines flexible tracks International collaboration for dynamic changes DARP reroutes	NAS-wide information network further facilitates new system applications
TFM	Defines flexible tracks Assigns fix crossing times	Defines flexible tracks International collaboration for dynamic changes DARP reroutes	Defines corridors
Airborne Equipment	Airborne collision avoidance system	Airborne collision avoidance system CDTI Cockpit multifunctional display (e.g., weather, etc.)	Airborne collision avoidance system CDTI Enhanced cockpit multifunctional display Additional applications

**Table 22-2. Evolution of Events in Oceanic Domain**

	<b>1998 Current</b>	<b>1999–2007 Steps 2 and 3</b>	<b>2008–2013 Step 4</b>
Users	<p>For non-west coast flights with no gateway reservation, flights enter oceanic airspace at lower than preferred altitude or are delayed due to 10 or more minutes longitudinal separation required</p> <p>Uses HF voice communications via communications service provider (e.g., ARINC)</p> <p>Some FANS-1/A data link communications</p> <p>Reroute requests are time-consuming for pilot</p> <p>Pilot sees some traffic on TCAS display, most traffic out of range</p> <p>Pilots report waypoint position reports</p> <p>Few self-separation procedures (in-trail climb/descent)</p>	<p>For equipped aircraft, communication going from domestic to oceanic is seamless (both using data link)</p> <p>For some FIRs, seamless interfacility transition</p> <p>May request more reroutes (less workload intensive for pilot)</p> <p>CDTI displays more traffic, and ADS-B provides additional information</p> <p>ADS-A-equipped aircraft automatically sends waypoint and periodic position reports</p> <p>Limited self-separation procedures using ADS-B (air-air) and CDTI (in-trail station-keeping, lead climb/descent)</p>	<p>Communications going from domestic to oceanic ATC seamless (mostly ATN)</p> <p>Seamless interfacility transition</p> <p>No need to request for reroute as long as maneuvers are within the corridor</p> <p>Pilot sees more traffic and weather information</p> <p>Able to fly preferred profile with shared separation responsibility</p>
Service Providers	<p>Altitude requests granted, if controller is not busy</p> <p>Ignores altitude profile information in flight plan; controller does not offer altitude change unless requested by aircraft or needed to resolve problem</p> <p>Reroute requests time-consuming for controller, limiting ability to grant requests</p> <p>Receives waypoint position reports from pilot</p> <p>Voice or teletype interface with other FIRs</p> <p>Prototype AIDC for limited data interface with other FIRs</p>	<p>Controller uses altitude profile information in flight plan for planning purposes</p> <p>Altitude requests more likely granted due to additional airspace available (e.g., RVSM), altitude profile information in flight plan, and controller less busy with manual tasks</p> <p>Reroute requests are more likely granted (less workload-intensive for controller)</p> <p>Receives ADS-A waypoint and periodic position reports from aircraft</p> <p>More data interface with other FIRs</p> <p>Automated decision support tools (including conflict probe) reduce reliance on paper strips</p>	<p>Few pilot position reports. Receives ADS-A position reports</p> <p>Flight Progress monitoring by exception</p> <p>Data communications interface with all other FIRs</p> <p>Flight Object processing facilitates handling change requests</p>

step in a logical or functional representation, without any intention of implying a physical design or solution. An overview of the sequence and relationship of the oceanic functionality with respect to the oceanic architecture is shown in Figure 22-3.

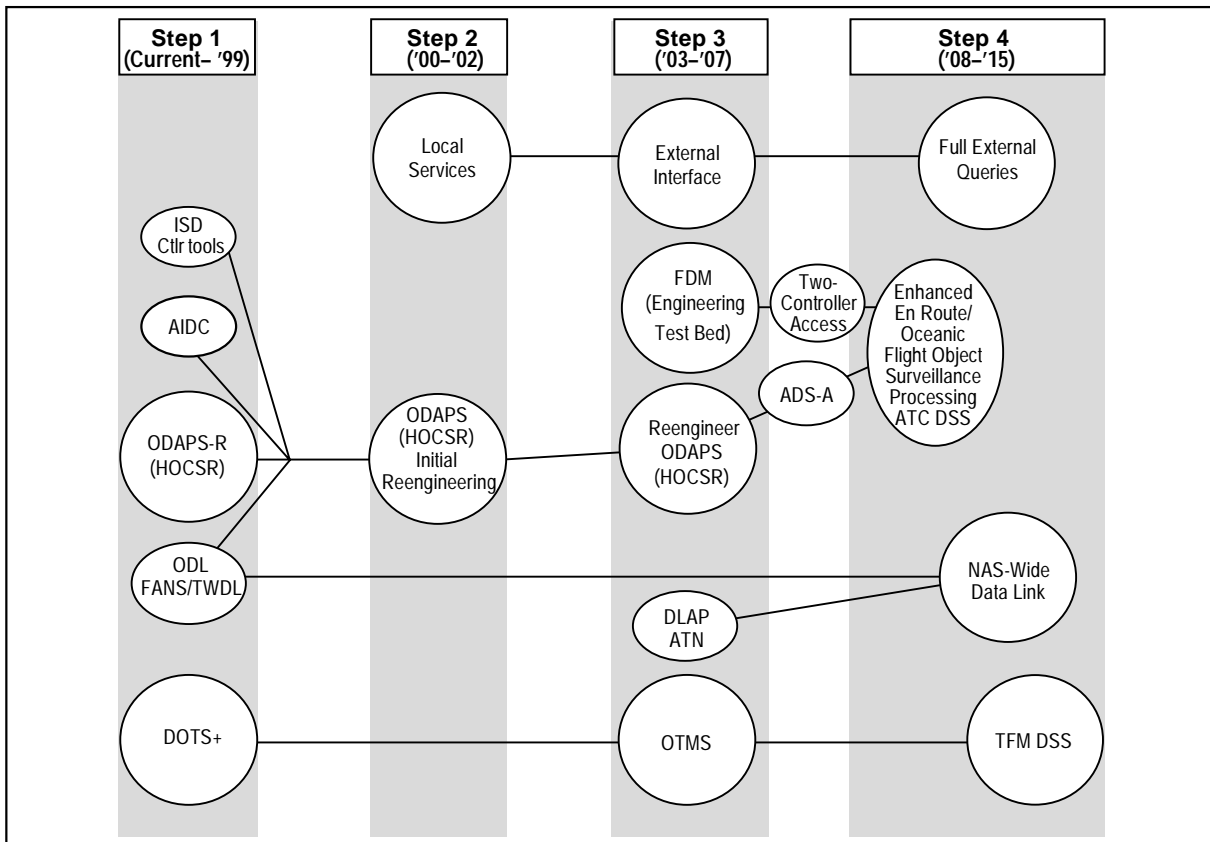
#### **22.1.1.1 Oceanic Architecture Evolution— Step 1 (Current–1999)**

Current oceanic ATC systems at New York and Oakland do not rely on radar coverage. Operations are performed through procedural separation using paper flight strips. Air-ground communication is indirect through a third-party, high frequency (HF) radio operator. Since direct radar surveillance is not possible over most of the ocean, aircraft report their positions to oceanic ATC at prescribed intervals or locations as they progress along their flight paths. Navigation is performed principally with onboard inertial navigation systems (INS) and communication by HF voice. To allow for INS errors and communications uncertainties (e.g., atmospheric disturbances, indirect voice relayed through a third

party and language problems), current oceanic separation minima are very large. Intensive coordination is required to ensure accurate communications between FIRs via teletype or telephone.

In the New York and Oakland centers, the Oceanic Display and Planning System (ODAPS) provides a situation display of aircraft positions based on extrapolation of periodic HF voice position reports and filed flight plans. ODAPS software was originally derived from the flight data processing software used by the en route Host computer system (HCS) and modified to meet oceanic-unique requirements. ODAPS also supports a procedural conflict probe capability. The ODAPS interim situation display (ISD) is currently used by service providers for planning and situational awareness. ISD does not yet provide the controller decision support tools required for it to be the primary means for procedural separation.

Oakland is currently using a limited version of oceanic data link (ODL) in a single sector. Oakland and New York sites have a telecommunica-



**Figure 22-3. Overall Oceanic Architecture Evolution**

tions processor (TP) that enables each sector controller to retain and search through ODAPS messages and messages received from the ARINC radio operators. The current oceanic workstations include an ISD and a TP/ODL prototype workstation that displays flight information. In addition, New York is using an air traffic services interfacility data communications (AIDC) prototype providing ground-ground data link between selected FIRs.

The oceanic centers also use the dynamic ocean track system (DOTS Plus) as a traffic management planning tool. DOTS Plus identifies optimal tracks based on favorable wind and temperature conditions, while projecting aircraft movement to identify airspace competition and availability.

An operational, procedural-based conflict probe will support reduced vertical separation minima (RVSM) and 50 nmi lateral through ODAPS. RVSM reduces vertical separation from 2,000 feet to 1,000 feet for aircraft in specified segments of oceanic airspace. Oakland implemented procedural changes to support 50 nmi lateral separation

for properly equipped aircraft and for required navigation performance (RNP)-10 aircraft in the North Pacific Ocean. Procedural changes and international coordination will enable RVSM to be extended to the entire Pacific Ocean for equipped aircraft. This step also brings enhancements to DOTS Plus. Figure 22-4 illustrates the logical oceanic architecture during Step 1.

Enhancements to the oceanic architecture during Step 1 include:

- Procedural-based conflict probe checks oceanic flight plans and proposed revisions for potential conflicts and provide an alert if separation minima are predicted to be violated.
- DOTS Plus improvements include hardware replacement and functional enhancements, such as improved weather data, elimination of duplicate message feeds, track definition message interface to ISD, remote monitoring and software maintenance, and an enhanced graphic user interface (GUI). DOTS Plus expands upon the previous DOTS track genera-

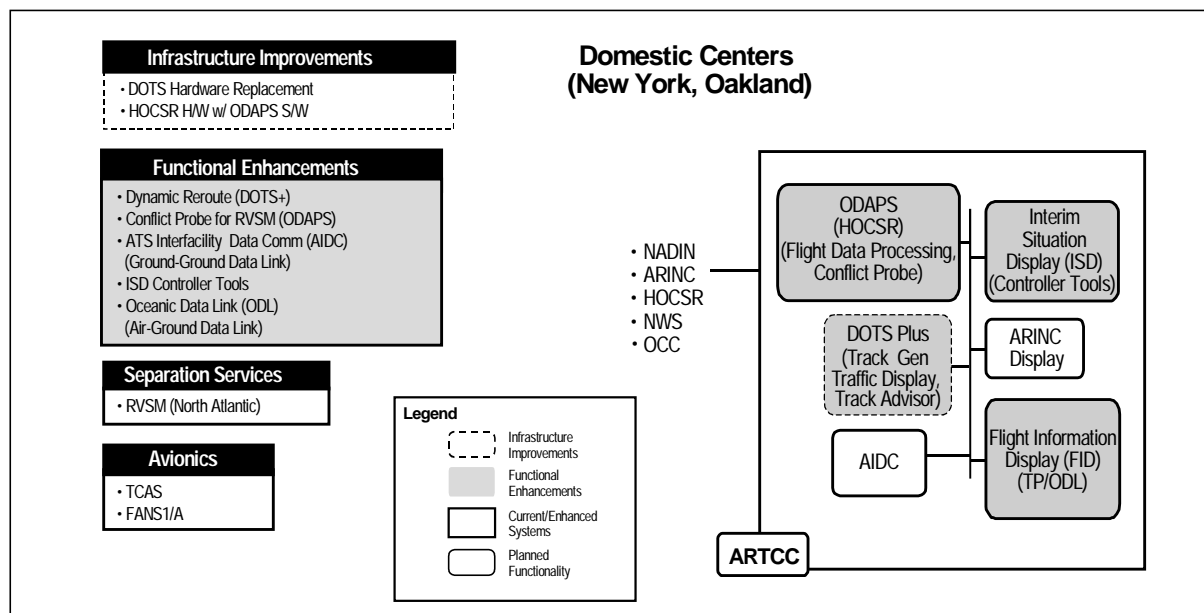


Figure 22-4. Oceanic Architecture Evolution—Step 1 (Current–1999)

- tion, traffic display, and track advisor functions and is capable of supporting flexible tracks and dynamic reroutes. DOTS Plus enhancements streamline the process accounting for weather and balancing loads, and allow the tracks to be updated more rapidly.
- Multisector ODL supports air-ground data link communications and extend single-sector data link functionality to all ODAPS sector positions. In this early phase, ODL windows are displayed to the oceanic service provider on the flight information display (FID). However, if ODL is not running, the FID displays telecommunications processor data. This multi-sector ODL capability, via ARINC as a data communications service provider, uses satellite communications for exchanging messages with FANS-equipped aircraft. Data link functions include automated entry of flight identification into a list of flights entering the sector, a display of messages to the track control position, and a transfer-of-communication message to aircraft exiting the FIR.
- Initial AIDC supports the ground-ground data link communications, which enables message/coordination to be exchanged between U.S. oceanic FIRs and their equipped, adjacent FIRs.
- The ISD tool set introduces automated decision support tools to the controller for calculating time, speed, and distance for head-on, in-trail, and crossing situations.
- The ODAPS hardware will be replaced to solve end-of-life-cycle and year 2000 problems. The en route program, Host/oceanic computer system replacement (HOCSR), will replace the en route and oceanic hardware. The current oceanic functionality will be sustained using the existing ODAPS software on the same hardware platform that is being used for the en route automation system. The economies of scale enabled by using common hardware for oceanic and en route applications will result in lower life-cycle costs. Moving to a common hardware platform will also provide a starting point for the evolution to a common software architecture to support oceanic and domestic ATC applications, as discussed in Section 21, En Route.

RVSM (North Atlantic) enables properly equipped aircraft to be cleared closer to their optimum altitudes and to be closer to the wind-optimal routes. Conflict probe helps enable conflict-free clearances and provides additional flexibility in granting user-requested routings in a timely manner. DOTS Plus provides flexible tracks, enabling the system to be more responsive to changing wind conditions.

Improved air-ground communications and coordination (enabled by ODL) will reduce the miscommunications inherent in messages relayed by voice. Data link and expanded radio coverage will provide direct pilot-controller communications, enabling more timely delivery of clearances by the oceanic service provider and responses from the flight deck. The AIDC will make similar improvements in ground-ground communications.

The ISD controller tools will provide oceanic service providers with further automation support, reducing the amount of time required by manually intensive computations. Along with conflict probe, these capabilities enable service providers to identify potential conflicts and to grant user-preferred routings and requests more frequently.

#### 22.1.1.2 Oceanic Architecture Evolution—Step 2 (2000–2002)

In Step 2, the Oakland and New York centers will refresh the oceanic flight data processing (FDP) hardware. Additionally, reengineering tasks will begin to accommodate additional surveillance and communication sources and to initiate commonality with the en route domain. The HOCSR platform will provide the basis for developing common en route/oceanic processing. Procedural changes and international coordination will enable RVSM to be extended to the Pacific Ocean for equipped aircraft.

Figure 22-5 illustrates the logical oceanic architecture during Step 2.

#### 22.1.1.3 Oceanic Architecture Evolution—Step 3 (2003–2007)

In Step 3, the Oakland and New York centers will incorporate the expanded AIDC message set and automatic dependent surveillance addressable (ADS-A). Figure 22-6 illustrates the logical oceanic architecture during Step 3.

Step 3 enhancements are outlined as follows:

- The expanded AIDC message set will allow oceanic service providers to send, receive, and display additional ground-ground data link messages between FIRs (i.e., coordination; transfer of communications; and emergency, miscellaneous, and general information messages).
- A two-controller access program will provide a fully functional oceanic data link position for an assistant controller in each sector, allowing shared sector responsibilities. The ODL windows will be displayed on both the FID and ISD and will be accessible from either position.
- A full-fidelity trainer will enable oceanic service providers to train in a realistic system simulation environment.
- ADS-A will enable FANS-equipped aircraft to automatically provide periodic position re-

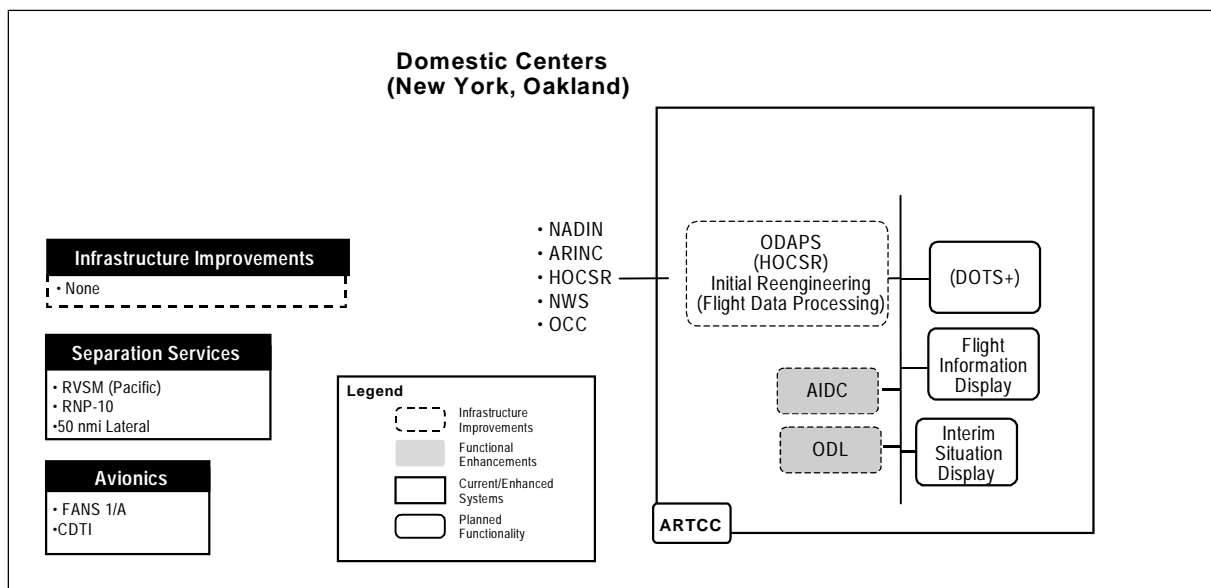
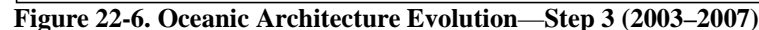


Figure 22-5. Oceanic Architecture Evolution—Step 2 (2000–2002)



- The oceanic architecture allows horizontal separation standards to be reduced to 50/50 nmi, enabling more aircraft to get closer to their wind-optimal routes. Increased frequency and accuracy (GPS-based) of position reports, combined with better controller-pilot communications, helps enable reduced separation standards without adversely affecting safety. ODL, high frequency data link (HFDL), and ADS-A will enable improved ground-air communications and more reliable and frequent surveillance data. DOTS Plus will be renamed the Oceanic Traffic Management System (OTMS) to reflect its expanded scope. The interface between the OTMS and the enhanced traffic management system

- The en route software reengineering efforts will accelerate in Step 3 to address domestic and oceanic commonality (see Section 21, En Route, for a detailed description).
- Ground automation upgrades to display supplementary flight data lists, along with accompanying procedural changes and approved DSS tools, will enable the elimination of paper flight strips.

A flight data management (FDM) prototype will be deployed at one ARTCC. When the FDM is operational, it will replace the existing flight data processing capability. The FDM prototype will be run in parallel with the existing FDP and serve as an engineering test bed. The FDM expands the existing ODAPS FDP capabilities by enabling the processing of the flight object (see Section 19). This development will enable implementation of a common FDM to support all domains. In brief, a flight object will contain information about a flight (planning through post-flight archiving and analysis) and will be accessible to all FAA service providers and authorized NAS users.

FANS-1/A two-way data link (TWDL) communications, ADS-A, and Air Traffic Services (ATS) facilities notification services will be provided and, as user equipage and demand dictate, ATN controller-pilot data link communications (CPDLC) will be provided. At this time, some oceanic and en route data link processing capabilities will be merged in the Data Link Applications Processor (DLAP). With the initiation of an oceanic communications interface into DLAP, ATN services can begin to be supported in oceanic airspace via DLAP. Aircraft equipped with data link applications, such as TWDL/CPDLC, will be flying in domestic en route airspace, as well as oceanic. Much of the communications software (e.g., FANS-1/A, ATN) needed for the ground systems will be common to both domains.

DLAP will provide multi-protocol and multi-application support for data link communications to aircraft flying in both oceanic and en route airspace. DLAP will mask the application differences from aircraft with different types of data link equipage and will present data link messages to the oceanic automation system in one common format for each application. The oceanic systems, therefore, will only have to include one version of each application (TWDL, ADS-A, and ATN), even though multiple airborne versions of each application are being supported.

Two-controller access provides oceanic controllers with the capability to more evenly distribute the workload associated with reducing separation minima and handling data-link-equipped aircraft during peak-traffic times. The transition to “strip-less” operations and the corresponding reduction in controller workload will enable oceanic service providers to meet expected increases in demand. Service providers will use visual displays and decision support tools to monitor the traffic situation and to separate traffic. They will do more strategic planning and grant more user preferences and requests. During this time frame, additional procedural improvements will be considered to allow limited self-separation procedures, such as in-trail station-keeping and lead climb/descent.

The expanded AIDC message set will provide improved coordination between the oceanic facilities and other international FIRs. The data link support for both FANS and ATN will take advantage of improved avionics and significantly improve ground-air communications. The common oceanic en route data link platform will facilitate seamless aircraft transitions and data transfers between the two domains.

#### 22.1.1.4 Oceanic Architecture Evolution—Step 4 (2008 and Beyond)

Figure 22-7 illustrates the logical oceanic architecture in this step. The evolution of oceanic and offshore systems to a common hardware and soft-

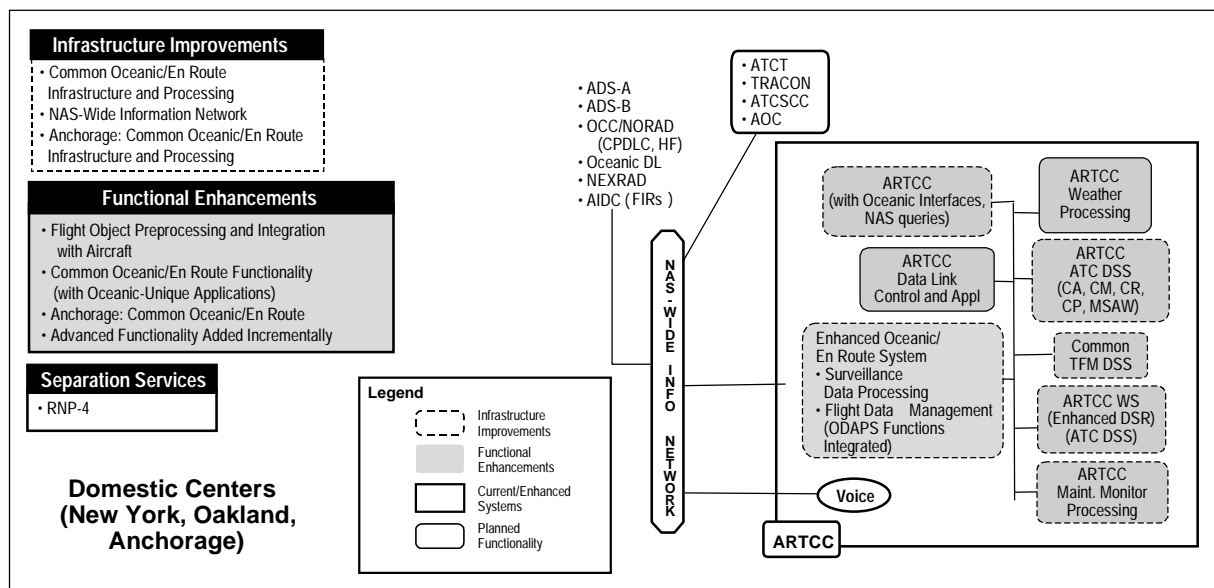


Figure 22-7. Oceanic Architecture Evolution—Step 4 (2008 and Beyond)

ware infrastructure with en route and terminal will be completed in Step 4. Oceanic operations at the Oakland, New York, and Anchorage centers will depend on the acquisition of the common enhanced oceanic en route system. An FDM will be implemented at all three sites, replacing the existing FDP. A common surveillance data processor for the en route, oceanic, and terminal domains will be implemented at each site with domain-specific modifications. The ISD and FID functionality will be integrated into the enhanced DSR workstation, which becomes the common ARTCC workstation. It is assumed that the enhancements made to the DSR during Step 3 of the en route architecture evolution will enable it to support oceanic requirements. A common ARTCC infrastructure will support common and unique oceanic and en route enhanced weather, decision support system, and maintenance applications. This common, modern infrastructure will provide the ground-based platform needed for developing many of the advanced functional enhancements (see Section 21, En Route).

Oceanic communications will continue to migrate from voice communications to data communications. While data communications becomes the primary means of communications, oceanic will continue to support a mixed equipage environment. Increased use of ADS, CPDLC, and AIDC will continue to reduce the need for manual coordination. The ability to communicate trajectory and route information (via CPDLC or TWDL) will enable increased granting of user-preferred routes. ADS-A will be integrated with an advanced conflict probe tool tailored for oceanic use. (see Section 17, Communications).

The NAS-wide information network will be structured to conform to NAS-wide data standards; to incorporate multilevel access control and data partitioning; to provide data security and allow real-time data access via queries; and to assume all data-routing and distribution functions, including data link. Planned functional enhancements, added incrementally to the system, may be able to support even further reductions in separation standards. These would include advanced functionalities, such as dynamic sector boundaries, conflict resolution, and 4-dimensional trajectories.

Expanded collaborative decisionmaking would enable further sharing of separation responsibility between the oceanic service provider and the flight crew. The pilot's ability to support climbs, descents, and crossing and merging routes will be supplemented by uplinked conflict probe information and display of more traffic and weather data. The oceanic service provider's ability to predict conflicts will be supplemented by pilot-intent information downlinked from the aircraft. Common TFM decision support tools will further improve coordination between oceanic and domestic facilities.

The full NAS-wide information network implementation will provide a uniform data format between oceanic and the en route and terminal systems. The ICAO message set will be supported and data communications interfaces will exist with all other equipped FIRs. Data link communications will be standardized, resulting in improved coordination and seamless interfacility transitions.

### **22.1.2 Offshore Architecture Evolution**

The current offshore oceanic ATC systems in Anchorage, Honolulu, San Juan, and Guam have partial radar coverage. The Anchorage and Honolulu TRACONs are not part of this domain and are discussed as part of the terminal architecture. The offshore facilities use the Microprocessor En Route Automated Radar Tracking System (MicroEARTS) for radar data processing of domestic and oceanic traffic wherever radar surveillance is available. The MicroEARTS are automated primary and beacon radar tracking and display systems whose functional capabilities are essentially the same as the terminal area ARTS IIIA radar data processing system, with the additional capability of employing both short- and long-range radar.

Table 22-3, Offshore Evolution Events, summarizes the major events that will occur at each offshore site as it evolves toward commonality with either the en route or terminal domain.

The following paragraphs present the offshore architecture evolution in more detail. Architecture diagrams show the content of each step in a logical or functional representation without any intention of implying a physical design or solution.

Table 22-3. Offshore Evolution Events

Step	Anchorage	Honolulu	San Juan	Guam
1. (1998–1999)	DOTS+ H/W replacement DOTS+ functionality CPDLC MicroEARTS	OFDPS-R (HOCSR) with OFDPS software MicroEARTS	Current system (Miami patch) MicroEARTS RDP	Current system (Manual FDP) MicroEARTS RDP
2. (2000–2004)	OCS rehost/replacement MicroEARTS upgrade DSR workstation ARTCC local information services ADS and data fusion	Additional HOCSR STARS/P <sup>3</sup> I Terminal controller workstation Terminal local information ser- vices ADS and data fusion	Terminal controller worksta- tion Local information services ADS and data fusion	STARS/P <sup>3</sup> I
3. (2005–2007)	ARTCC local information services upgrade NAS-wide information network	Local information services upgrade NAS-wide information network SDP	STARS/P <sup>3</sup> I Local information services upgrade SDP NAS-wide information net- work	Terminal controller workstation ADS and data fusion Local information services upgrade SDP NAS-wide information network
4. (2008 and beyond)	Common infrastructure with en route	Common infrastructure with ter- minal	Common infrastructure with terminal	Common infrastructure with terminal

### 22.1.2.1 Offshore Architecture Evolution— Step 1 (Current–1999)

Figure 22-8 depicts Step 1 of the offshore architecture for the four offshore sites: Anchorage, Honolulu, San Juan, and Guam.

#### Anchorage

Anchorage uses a unique flight data processing system—the offshore computer system (OCS). OCS processes oceanic flight data and implements its own version of data link for FANS-equipped aircraft in Anchorage ARTCC airspace,

including offshore and oceanic sectors. OCS also provides flight data to the MicroEARTS radar data processor. An existing AIDC prototype system will become operational to support a ground-ground data link with other international FIRs. The sector layout at Anchorage will also include a DSR workstation that is connected to the MicroEARTS, which will replace the current radar display. While Anchorage will be using the DSR common console hardware (driven by the MicroEARTS and the OCS), it will not be using the DSR software.

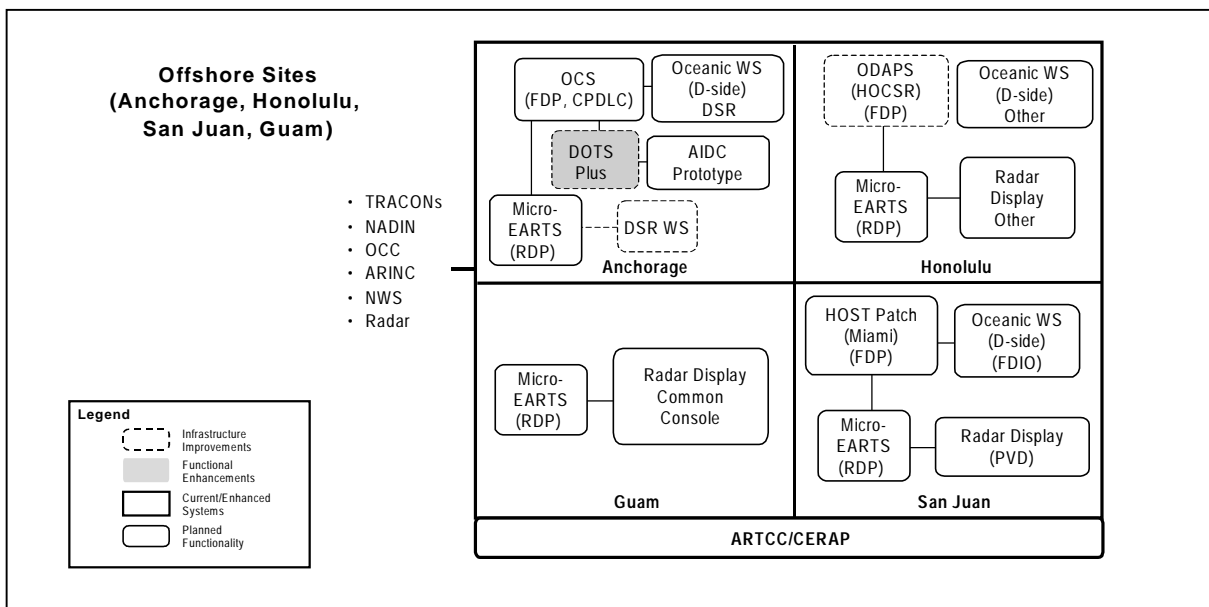


Figure 22-8. Offshore Architecture Evolution—Step 1 (Current–1999)

Anchorage (like New York and Oakland) also has the automated planning tool, DOTS Plus. DOTS Plus implements track generation and track advisor functions and interfaces with the National Airspace Data Interchange Network (NADIN) for the exchange of track information and aircraft position reports. Scheduled DOTS Plus improvements include hardware replacement and functional enhancements, such as improved weather data, elimination of duplicate message feeds, remote monitoring and software maintenance, and an enhanced GUI.

Anchorage implemented procedures to support reduction to 50 nmi lateral separation for RNP-10 aircraft in the North Pacific Ocean (NOPAC) in April 1998.

### **Honolulu**

In Honolulu, the CERAP uses the Offshore Flight Data Processing System (OFDPS), which is based on modified ODAPS software and is interfaced to a MicroEARTS radar data processor. An OFDPS communications system provides a channel for external interfaces to communicate with OFDPS. The MicroEARTS system, commissioned in January 1998, provides new controller workstations. The OFDPS will be rehosted as part of the En Route HOCSR program, so the HOCSR hardware will be using existing OFDPS application software during this period. (See Section 21, En Route).

### **San Juan**

In San Juan, the CERAP obtains flight data information remotely from the Miami ARTCC (Miami patch), which is transmitted to the replacement flight data printers (RFDPs). San Juan uses the plan view display (PVD) for MicroEARTS controller positions. San Juan commissioned the MicroEARTS system in early 1998.

### **Guam**

Guam currently uses MicroEARTS with common consoles that function as situation displays at each sector. (MicroEARTS was commissioned in March 1997.) Flight plans are received over an aeronautical fixed telecommunications network (AFTN) circuit, and flight strips are printed using a PC-based program. All flight plans are manually entered into MicroEARTS, and all flight data processing is done manually by the controllers.

No new improvements are scheduled prior to Step 2.

### **22.1.2.2 Offshore Architecture Evolution—Step 2 (2000-2004)**

Figure 22-9 depicts Step 2 of the offshore architecture for the four offshore sites.

#### **Anchorage**

Due to aging equipment, the OCS will be rehosted (OCS-R) onto a more modern platform that includes a reengineered flight data processor that is based upon the existing OCS software. MicroEARTS functionality may be upgraded with ADS-A, ADS-B, data fusion, and improved weather data as a part of the Safe Flight 21 and Capstone demonstration programs. This ADS-B and data fusion capability will be needed to support objectives of these programs. Information sharing will be implemented via the initial ARTCC local information services and will incorporate unique local interfaces.

#### **Honolulu**

An additional HOCSR will be deployed to support the transition from the CERAP's present Diamond Head location. The existing HOCSR will be maintained as a backup during the transition period. After the relocation, the MicroEARTS will be replaced by STARS and terminal controller workstations. The STARS functionality will be upgraded to coincide with the STARS preplanned product improvements (P<sup>3</sup>I) (see Section 23, Terminal). Information sharing will be implemented via the initial local information services and will incorporate unique local interfaces.

#### **San Juan**

The Miami patch for the San Juan FDP process will remain unchanged during this period. Information sharing will be implemented via the local information service and will incorporate unique local interfaces.

#### **Guam**

The STARS with the terminal controller workstations will replace the existing MicroEARTS system and common consoles. The STARS functionality will be upgraded to coincide with the STARS P<sup>3</sup>I (see Section 23, Terminal). Infor-

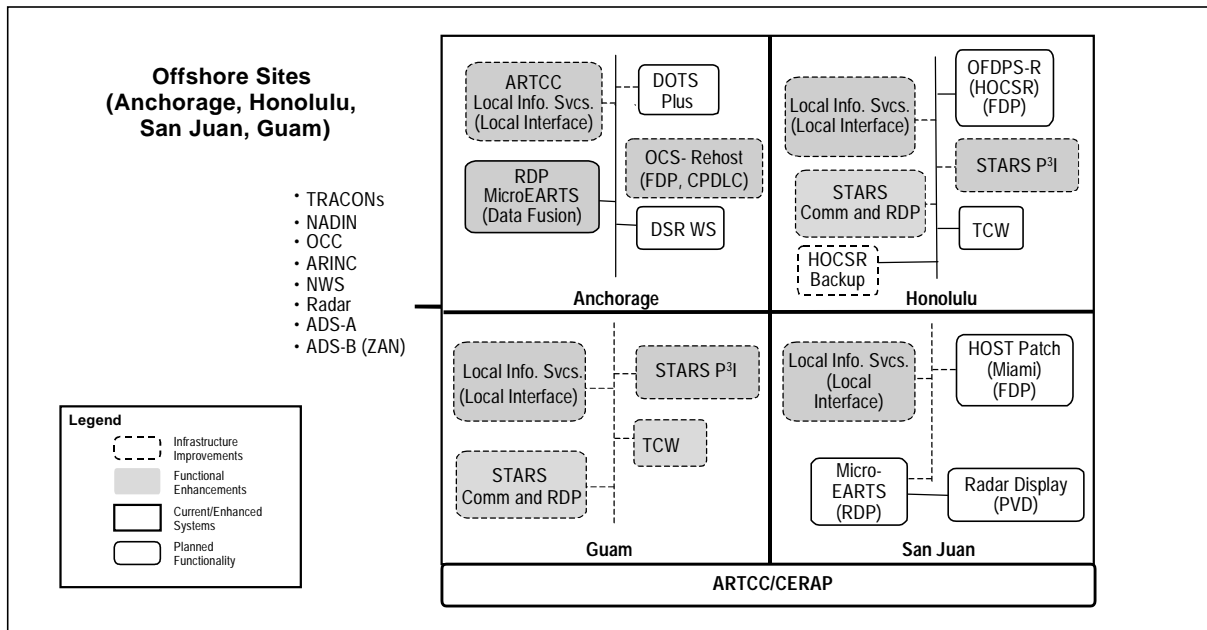


Figure 22-9. Offshore Architecture Evolution—Step 2 (2000–2004)

mation sharing will be implemented via the local information services deployed at Guam and will incorporate unique local interfaces.

### 22.1.2.3 Offshore Architecture Evolution— Step 3 (2005–2007)

Figure 22-10 depicts Step 3 of the offshore architecture for the four offshore sites.

#### Anchorage

The OCS-R will continue providing FDP functionality. The ARTCC local information services at Anchorage will be upgraded and unique oceanic interfaces will be incorporated. The local information services will provide the capability for a data repository, in accordance with standards developed for the NAS-wide information network (see Section 19, NAS Information Architecture

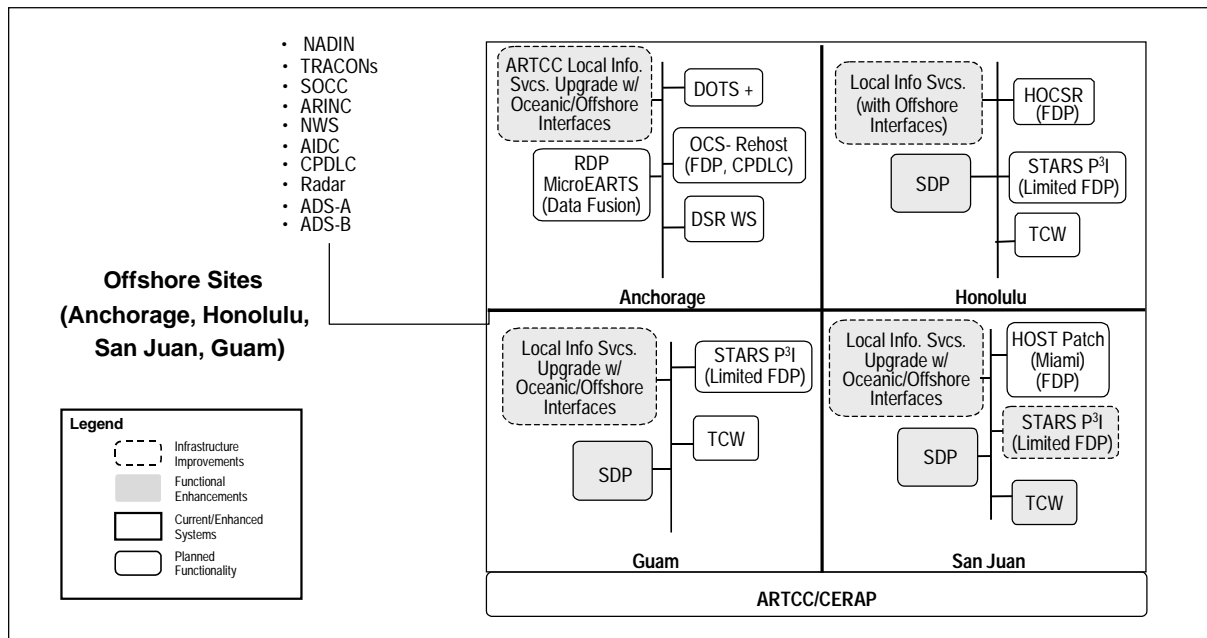


Figure 22-10. Offshore Architecture Evolution—Step 3 (2005–2007)

and Services for Collaboration and Information Sharing), that will enable the sharing of common information between FAA facilities.

### Honolulu, San Juan, and Guam

San Juan's MicroEARTS system will be replaced by the STARS and the terminal controller workstation (TCW). The STARS functionality will be upgraded to coincide with the annual deployment of STARS P<sup>3</sup>I enhancements (see Section 23, Terminal). The common reengineered surveillance data processor (SDP) will be deployed. Limited FDP capabilities will also be provided in STARS during this period. Upgraded local information services with unique offshore interfaces will be deployed along with the NAS-wide information network.

#### 22.1.2.4 Offshore Architecture Evolution—Step 4 (2008 and Beyond)

Figure 22-11 depicts Step 4 of the offshore architecture for the four offshore sites.

### Anchorage

This step initiates the evolution from the MicroEARTS/OCS-R-based oceanic flight data management, surveillance data processing, and initial oceanic ATC decision support systems to more advanced functionality and a common infrastructure with en route. The goal is to achieve infrastructure commonality (e.g., common hardware

and system software). The applications software will be common where appropriate but will also comply with the domain unique requirements necessary for operational suitability. The Anchorage system will have the architecture and capabilities described in Step 4 of the oceanic architecture evolution (see Section 22.1.1.4).

### Honolulu, San Juan, and Guam

In this step, Honolulu, San Juan, and Guam will evolve from offshore site domains to an infrastructure common with the terminal domain. This step will fully implement electronic flight data management by using flight objects and the NAS-wide information network. The common infrastructure will include flight data management (FDM), surveillance data processing, and initial TRACON/offshore automation decision support systems. The goal is to achieve infrastructure commonality (e.g., common hardware and system software). The applications software will be common where appropriate but will also comply with the domain unique requirements necessary for operational suitability (see Section 23, Terminal).

### 22.2 Summary of Capabilities

Oceanic operational improvements are centered around improved automation systems; procedural improvements; and advanced communications, navigation, and surveillance capabilities. In the near term, RVSM will enable increased airspace

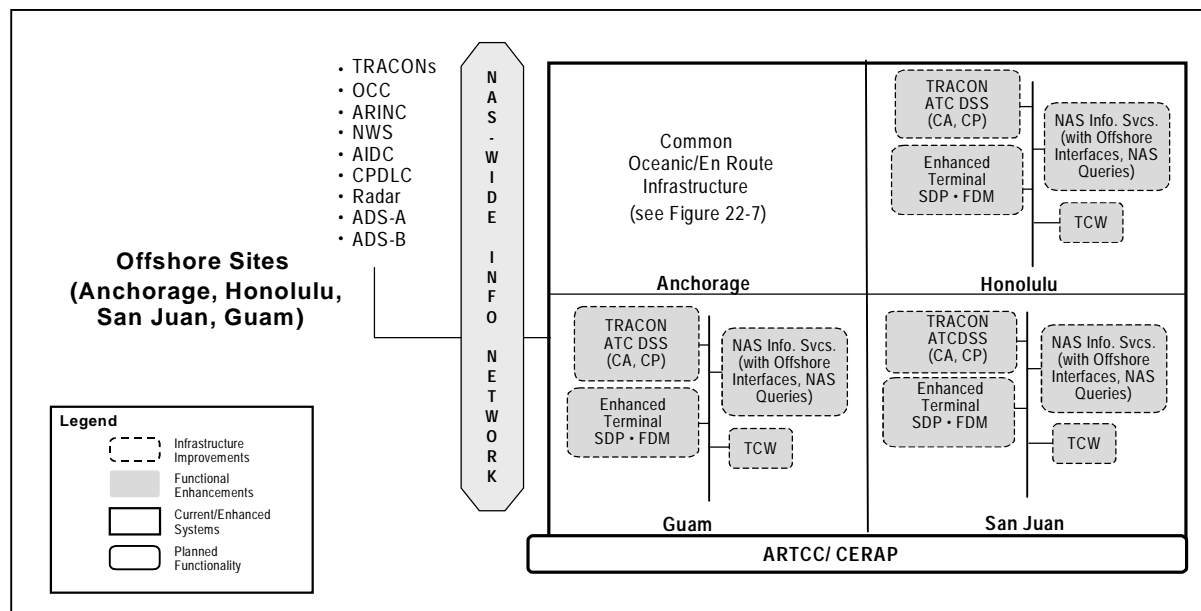


Figure 22-11. Offshore Architecture Evolution—Step 4 (2008 and Beyond)

capacity, and ODL and DOTS Plus will support dynamic rerouting and separation verification. Aircraft equipment and procedural improvements will allow the separation standards to be reduced to 50 nmi lateral in more oceanic airspace.

Automation enhancements, multi-sector ODL, ADS-A, and AIDC will enable separation standards to be reduced to 50 nmi lateral and 50 nmi longitudinal in some oceanic airspace and then eventually in all oceanic airspace. Procedural improvements, in conjunction with separation from the glass and stripless operations, may allow separation standards to be reduced beyond 50/50 nmi in some oceanic airspace. Sharing common information between oceanic and domestic sites and international FIRs will improve coordination.

Migration to an enhanced en route/oceanic automation system with advanced decision support tools and dynamic sector boundaries will support the capability for further reduction of oceanic separation standards.

The NAS-wide information network will facilitate sharing control data for collaboration between national and international air traffic service providers to determine the daily airspace structure (based on weather, demand, user preferences, and equipment), to identify and mitigate capacity problems, and to ensure seamless transition across FIR boundaries. The NAS-wide information network will improve collaborative decisionmaking between FAA and users—as will timely data link sharing of information between the oceanic service provider and the cockpit. Figure 22-12 de-

picts the evolution of oceanic and offshore operational capabilities.

### 22.3 Human Factors

Human factors methods, principles, and practices will be applied during the oceanic evolution process. Understanding the human factors issues associated with the oceanic implementation of ADS, improved navigation tools, real-time communications, and automated data exchange between pilot and oceanic service provider via data link is required. Displays and decision support tools will support the goals of increasing flexibility and efficiency through implementing dynamic rerouting (e.g., step climbs, cruise climbs, and optimum altitudes) and dynamic management of route structures (i.e., flex tracks and user-preferred profiles).

To achieve these goals requires a better understanding of which decisions to support and what specific functions DSSs will perform. Furthermore, to integrate the system across domains, boundaries, and authorities will require an in-depth understanding of the communication process between controllers in the system and how this process can be automated.

The human factors aspects of this new process will be critical, since the improved communication level and less rigid structure in the airspace will need new methods for presenting information to controllers and other users.

The primary elements of the required information to make this transition include the definition of

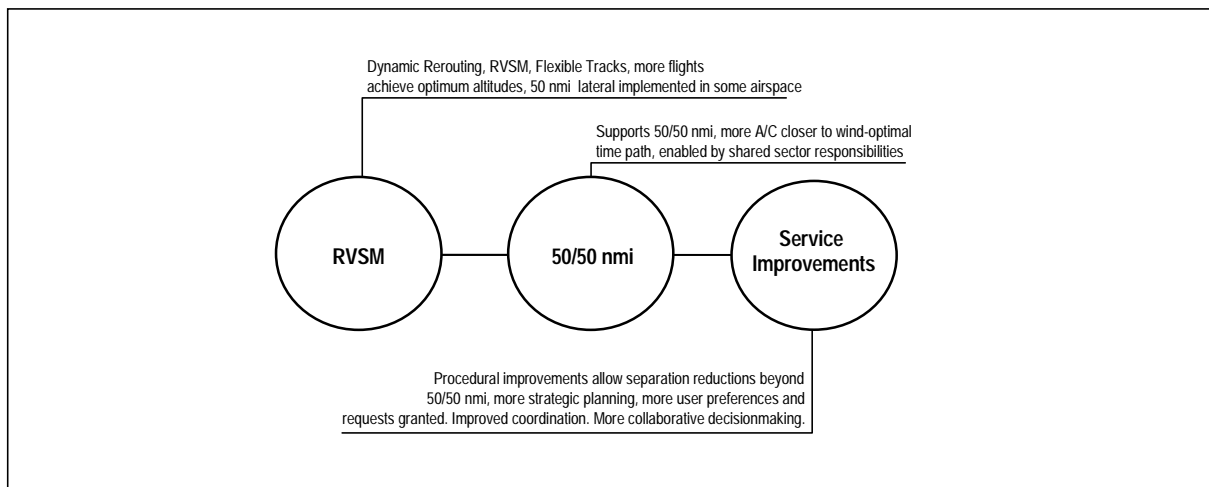


Figure 22-12. Oceanic and Offshore Operational Improvements

service provider and user functions, decision processes, information requirements, and communication processes that are necessary to accomplish the goals. This information makes it possible to integrate flight-strip information on the primary oceanic display in a manner that allows for the elimination of paper flight strips.

Human factors guidance will be provided in the area of oceanic automation and decision support systems to ensure that they will provide the anticipated user and service provider capabilities. The DSS must detect deviations and account for required oceanic procedural separation rules. Issues requiring resolution include accuracy and sensitivity of the algorithms versus the false alarm rates that are acceptable to service providers. Tools must be developed to help system designers understand what decisions should be supported, the best means to deliver the information to the service provider, and how to elicit knowledge from experts during the algorithm development process.

Using oceanic data link to issue altitude assignments, frequency changes, clearances, and weather hazard alerts will contribute to efficiency. There are human factors issues to be resolved regarding the ability of oceanic service providers to ensure that the correct messages are sent, properly received, and acknowledged. Human factors research needs to be conducted to refine and augment the human engineering guidelines for system development in data link communications to ensure that providers and users sustain or enhance their current level of situation awareness using data link communications during oceanic operations.

The process of TFM in future oceanic operations will depend heavily on collaborative decision-making. That is, information will be shared between service providers and users so that both parties can optimize the process of flight scheduling, routing, and maneuvering. Human factors research is required to develop alternative methods for interaction between users and service providers to enhance oceanic flexibility. The research needed encompasses development of analytical tools to evaluate the human factors aspects of how collaborative decisionmaking (CDM) will be conducted from the standpoint of communication and

information transfer between users and oceanic service providers.

Inclusion of the flight deck in some shared separation responsibility requires additional human factors research to address the issues of flight deck information requirements and cross-system integration. The issue of responsibility (e.g., specific procedures and rules of the road) will be addressed and resolved before shared separation decisionmaking/responsibility occurs on the flight deck. A concerted effort will be directed at determining the capabilities and limitations of pilots and controllers so that it will be possible to change the oceanic concept of operations in a manner that results in the requisite increase in efficiency and safety.

Considerable human factors guidance is required for successful transition between stages of the oceanic system evolution process. This includes implementing data link communications and processes and the transition from procedural separation using paper strips to procedural separation using displays with integrated DSS tools.

## 22.4 Transition

The oceanic and offshore transition is shown in Figure 22-13.

### 22.4.1 Oceanic Elements

The principal elements of the transition to the oceanic architecture are as follows:

- DOTS Plus implemented at Oakland and New York
- ODL, ISD controller tools, and initial AIDC deployed at Oakland and New York
- ODAPS hardware at Oakland and New York rehosted onto the same type of platform as the Host sustainment platform (HOCSR)
- ADS-A software deployed at Oakland and New York; communications server supports ODL, ADS-A, and AIDC

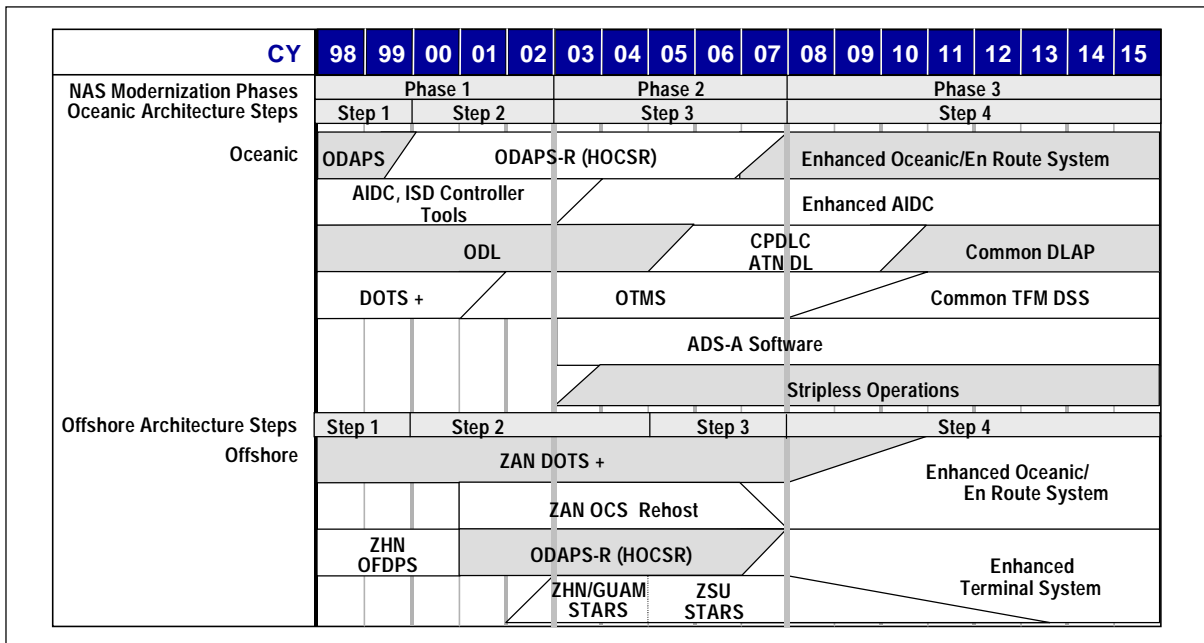


Figure 22-13. Oceanic and Offshore Transition

- OTMS functionality upgrades at Oakland and New York
- TCA, Full-Fidelity Trainer, Enhanced AIDC
- Transition to stripless operations at Oakland and New York
- FDM prototype deployed as engineering test bed
- Common DLAP supporting oceanic and domestic data link
- Introduction of NAS-wide information network
- Common oceanic/en route system deployed at Oakland, New York, and Anchorage
- Common terminal/offshore system deployed at Honolulu, San Juan, and Guam
- Functional enhancements are implemented to fully satisfy mid-term CONOPS.
- STARS deployed at Guam and Honolulu
- Introduction of Local Information Services at offshore sites
- STARS deployed at San Juan
- Introduction of NAS-wide information network at offshore sites
- Common terminal infrastructure for Honolulu, San Juan, and Guam
- Common oceanic/en route system for Anchorage
- Functional enhancements are implemented to fully satisfy mid-term CONOPS.

## 22.5 Costs

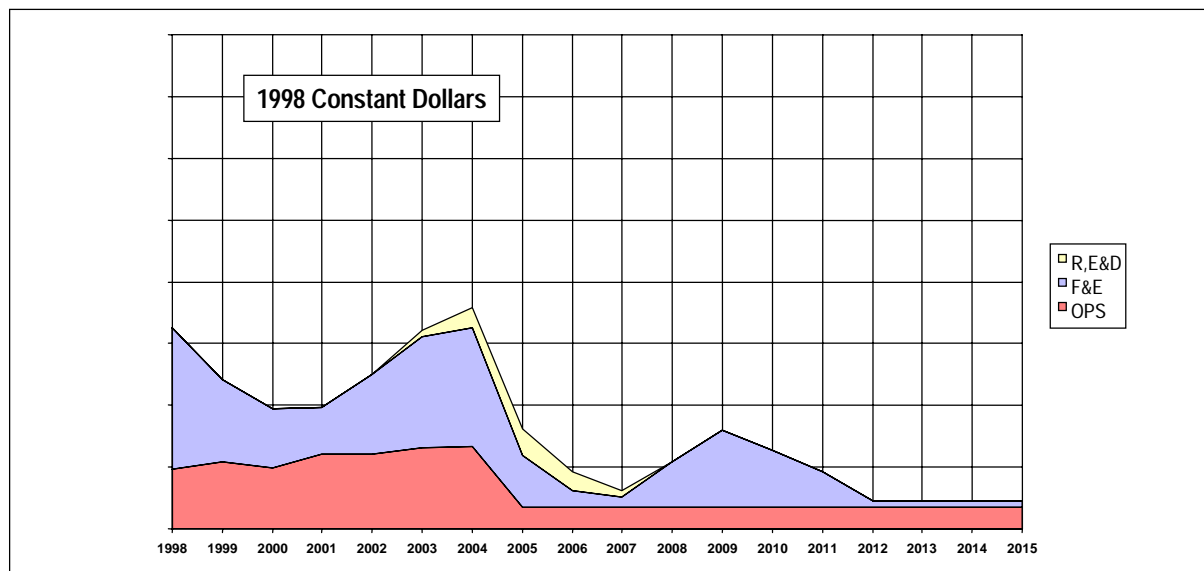
The FAA estimates for research, engineering, and development (R,E&D); facilities and equipment (F&E); and operations (OPS) life-cycle costs for oceanic and offshore architecture from 1998 through 2015 in constant FY98 dollars are presented in Figure 22-14.

## 22.6 Watch Items

A current study is investigating a number of innovative alternatives to meet oceanic user needs and FAA commitments to reduce separation standards. This effort focuses on an FAA/industry partnership to deliver benefits earlier than is cur-

### 22.4.2 Offshore Elements

- The principal elements of the transition to the offshore architecture are:
- DOTS Plus implemented at Anchorage
- OFDPS replaced at Honolulu (HOCSR)
- OCS replaced at Anchorage



**Figure 22-14. Estimated Oceanic and Offshore Costs**

rently affordable with FAA funding. System capacity will not keep pace with growth in traffic volume until improvements are made to the oceanic ATC system.

The oceanic and offshore architecture evolution will require new procedures, regulations, standards, and certification of all systems whose failure could affect flight operations safety. New operating procedures will be required for reduced separation standards, flexible routing, and increased use of automated information exchange between aircraft, service providers, and international FIRs. Standards for message formats and content must be generated and agreed upon internationally.

Implementing oceanic capabilities and achieving the oceanic and offshore functionality and subsequent operational benefits described in the architecture depends on adequate funding, which has been and continues to be a problem. Thus, successful implementation of the oceanic architecture will depend on the success of related activities in other domains (described below).

- Demonstrate the ability of ground automation systems to process improved surveillance, intent, aircraft state, and wind data from both Mode-S downlink and ADS; to merge these

data with radar data and pilot position reports; and to display this information to controllers with an acceptable computer-human interface (CHI)

- Timely deployment of ODAPS, OFDPS, and OCS hardware supportability solutions that solve the infrastructure replacement problems in the near term and provide a bridge to the new capabilities of the evolving systems necessary to meet future requirements
- The budget for incorporating some of the future functionality is related to development of common algorithms to provide this functionality across domains where appropriate. Areas where common functionality across domains is anticipated are:
  - Surveillance processing and ADS data fusion in the terminal, en route, oceanic, and surface domains
  - Weather services
  - Flight object processing (FDM)
  - Functionality in some ATC DSS and safety-related tools.